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Soil Survey
of
Collin County, Texas

By

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and
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Texas Agricultural Experiment Station

Bureau of Chemistry and Soils

In cooperation with the
Texas Agricultural Experiment Station

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SOIL SURVEY OF COLLIN COUNTY, TEXAS

By M. W. BECK, in Charge, and E. G. FITZPATRICK, United States Department of Agriculture, and L. G. RAGSDALE, Texas Agricultural Experiment Station

COUNTY SURVEYED

Collin County is in northeastern Texas (fig. 1), about 30 miles south of the northern boundary of the State. McKinney, the county seat, is 34 miles northeast of Dallas. The county is approximately 30 miles square and comprises an area of 878 square miles, or 561,920 acres. It lies entirely within the Black-land Prairies.

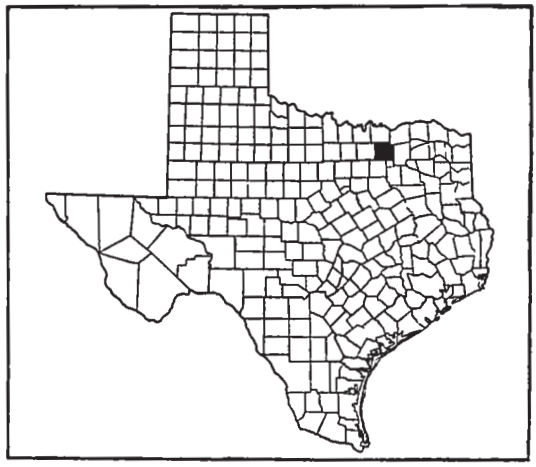

FIGURE 1.—Sketch map showing location of Collin County, Tex.

Physiographically, the area of Collin County includes parts of two plains separated by a northeast-southwest escarpment ranging from 50 to 100 feet in height. Both plains are essentially alike, both being smooth, except for dissection by a number of streams. The dissection is shallow and somewhat incomplete. The land is rolling, with comparatively small flat undissected remnants of the original plain surface, the largest of which lies west of the White Rock Escarpment on the Denton County line, and in the vicinities of McKinney, Clearlake, Melissa, and Anna.

The elevation ranges from about 435 to more than 700 feet above sea level. The lowest point is where East Fork Trinity River leaves the county, and probably the highest is on the divide between Honey Creek and East Fork Trinity River on the Grayson County line. The elevation (*3*)[1] at McKinney, in the central part, is 592 feet. The general slope is toward the southeast.

Most of the land is drained by streams tributary to Trinity River, almost all the drainage being rapidly afforded by the many creeks and branches which comprise the drainage system of East Fork Trinity River. A small area in the southeastern part is drained by headwater streams of Sabine River.

[1] Italic numbers in parentheses refer to Literature Cited, p. 26.

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The area included in Collin County before settlement was grassland, although originally some trees, chiefly elm, hackberry, bois d'arc, and pecan, with some willow, ash, and bur oak, grew in the stream valleys. Some of the flat areas of the upland had, before cultivation, some clumps of small elm, bois d'arc, and hackberry trees. The more severely eroded slopes were occupied by a fairly thick growth of Spanish oak, shin oak, redbud, sumac, and some cedar and pecan. The prairies were originally covered with a dense growth of native grasses, bluestem (*Andropogon* sp.) being predominant. These coarser prairie grasses are reported to have attained a height of 2 or 3 feet, and they afforded excellent grazing. Buffalo grass (*Bulbilis dactyloides*), locally called mesquite grass, is a native short grass, that grew in places, and small amounts of this grass still remain. Probably less than 200 acres of the unbroken virgin prairie land are left.

Collin County was formed in 1846 from a part of Fannin County. The first settlers are said to have come from Tennessee, Kentucky, and Arkansas, about 1841. In 1880, the population was 25,983, and in 1930, it numbered 46,180. The density of population is 52.6 persons a square mile, and the people are rather evenly distributed. The first county seat was at Buckner, which was about 3 miles northwest of McKinney, but it was moved to McKinney in 1848. McKinney, with 7,307 inhabitants, is the only town exceeding 2,500, although many people live in the villages and small towns. Farmersville, Plano, Frisco, Prosper, Celina, Allen, Melissa, Josephine, Wylie, and Anna are small towns and railroad and trading points. Of the rural population, 26,910 are classed as rural farm and 11,963 as rural nonfarm. The colored population numbers 3,979.

Transportation facilities are excellent. In addition to the steam and electric railway lines, most sections are served by bus and truck service. The St. Louis, San Francisco & Texas Railway serves the western part of the county; the Texas & New Orleans Railroad, the Texas Electric Railway, and the Louisiana, Arkansas & Texas Railway serve the central part; the St. Louis Southwestern and the Gulf, Colorado & Santa Fe Railways pass through the southern and eastern parts; and the Missouri, Kansas & Texas Railroad passes through the extreme southeastern corner. No farm is more than 8 or 10 miles from a railroad shipping point.

Good roads are numerous. Hard-surfaced roads extend from Dallas, Dallas County, through McKinney to Sherman, Grayson County, and from Dallas through Wylie and Farmersville to Desert. The Dallas-Greenville paved highway passes through the extreme southeastern corner. Most of the main roads connecting towns and villages are surfaced with gravel, but many of the secondary roads are of earth construction, are well graded and dragged, but become impassable for automobiles after heavy rains.

All sections are reached by rural mail delivery routes and telephone lines. Good schools and churches are located at convenient intervals.

The only important manufacturing industries are a cotton mill, cottonseed oil mill, and flour mill in McKinney and a cottonseed-oil mill in Farmersville. Many cotton gins are located in convenient places.

CLIMATE

Collin County has a temperate and healthful climate. The winters are short but are marked by sudden changes of temperature caused by the southerly extension of cold waves from the Northwest. These are characterized by north winds, locally called "northers", accompanied frequently by rain which occasionally changes to sleet and sometimes to snow. The cold spells are, as a rule, of short duration, generally lasting only a few days. The summers are long, and high temperatures prevail, but the heat is tempered by southerly breezes.

The mean annual temperature at McKinney is 64.9° F. The lowest recorded temperature is 1° above zero and the highest is 108°, but extremes of either heat or cold are infrequent and continue for only short periods.

The average date of the last killing frost is March 29, and of the first is November 13, giving an average frost-free season of 229 days. Frost has been recorded as late as May 1 and as early as October 9. The fruit crop is occasionally damaged by late frosts, and fall-planted oats are sometimes killed by winter freezes. Vegetables are successfully grown in the spring and early fall, but few can be grown during the hottest part of summer.

The county lies in the humid section of Texas. The precipitation is somewhat variable, with occasional periods of too much or too little rain for best results in growing crops. Unfavorable conditions, caused by excesses or deficiencies in soil moisture, are accentuated by the prevailingly heavy clay texture of the soils which cannot be worked except within a narrow range of moisture content. Corn is often injured by short periods of summer drought, though cotton is much less susceptible to moisture deficiencies. Injury to winter oats and wheat is sometimes caused by too little rain in fall and winter, as such dry seasons do not allow sufficient soil moisture to be stored for spring-planted crops.

The average annual precipitation at McKinney is 42.24 inches. The average annual depth of snowfall is 1.9 inches, and some winters pass without any snow. The rainfall is usually well distributed throughout the year, with the spring months receiving the greatest amount. Prolonged severe droughts are rare, and periods of excessive rainfall are not frequent. Local hailstorms, confined to small areas, sometimes occur, and occasionally high winds do some damage. The greatest damage done by heavy rains is in washing away the soil from unprotected fields.

The climate allows the successful growing of cotton, corn, wheat, oats, onions, spring and fall vegetables, fruit, and hay crops.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation, as recorded by the United States Weather Bureau station at McKinney.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at McKinney, Collin County, Tex.*

[Elevation, 612 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1925)	Total amount for the wettest year (1877)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	46.4	79	8	3.03	(1)	9.10	0.2
January	44.9	84	1	2.45	1.38	.50	1.4
February	48.4	95	1	3.17	1.43	13.06	.2
Winter	46.6	95	1	8.65	2.81	22.66	1.8
March	56.8	95	17	3.18	1.18	3.10	.1
April	64.3	95	25	5.02	3.12	9.95	.0
May	71.3	103	27	6.45	4.50	3.97	0
Spring	64.1	103	17	14.65	8.75	17.02	.1
June	79.7	108	44	4.14	.53	6.28	.0
July	83.2	108	51	2.95	.69	1.98	.0
August	83.7	108	53	2.48	.54	1.05	.0
Summer	82.2	108	44	9.57	1.76	9.21	.0
September	77.4	107	39	3.02	1.83	3.23	.0
October	67.1	98	15	3.59	4.18	12.00	.0
November	55.8	89	18	2.76	1.43	12.00	(1)
Fall	66.8	107	15	9.37	7.44	27.23	(1)
Year	64.9	108	1	42.24	20.76	76.12	1.9

[1] Trace

AGRICULTURAL HISTORY AND STATISTICS

The early settlers located near streams, where water could be obtained easily and wood was available for fencing, fuel, and building purposes. They raised cattle, horses, and sheep on the open range. Small patches of land were fenced with rail fences, and corn, wheat, and oats were grown for home use. Cotton was grown only on small areas prior to the Civil War. Some hogs were raised and were allowed to run wild in the woods. Wheat was ground into flour or hauled by ox teams to Jefferson, where supplies were purchased and brought back.

At that time, all the land in the county was free range, but, with the introduction of barbed wire about 1874, more land was fenced and larger tracts put in cultivation. The building of the Houston & Texas Central Railroad through Collin County in 1873 furnished an outlet for farm crops, and farming increased rapidly. Although the first settlers established themselves near the streams, settlements gradually extended to the prairies, and the farmers soon realized that the black prairie land was highly productive. For many years during the early stages of settlement, land could be bought at prices ranging from $2 to $10 an acre, depending on improvements.

Collin County is now thickly settled with people engaged almost entirely in agricultural pursuits on small or medium-sized well-

improved farms. The chief industry is general farming, with the main interest centered in the production of cotton as a cash crop. Some farmers devote only a small acreage to other crops, and some grow a rather large quantity of wheat and oats. Most farmers produce some of the feed crops, mainly corn, sorgo, grain sorghums, and hay, but, as a rule, the aim is to grow only sufficient feed to supply local needs. A very large proportion of the farms are operated by tenants, and on these farms, as a rule, the acreage in cotton far exceeds that in all other crops. On most farms operated by owners, and many by tenants, the crops grown are fairly well diversified, but on nearly all farms the cotton crop dominates. In addition to growing cotton, many farmers grow wheat or oats and sufficient feed crops to supply the yearly need of the farm livestock. Many such farmers supply much of their home food requirements by keeping a few milk cows, swine, and good-sized flocks of chickens, as well as having small vegetable gardens and a few fruit trees. All such products, not needed in the home, are marketed locally or sold to buyers for shipment to the larger markets. Thus many farmers have developed a more specialized type of farming, and the sale of milk, cream, chickens, and eggs annually amounts to a large sum. The surplus milk and butter are sold in local towns, and the extra cream is shipped to Dallas and other outside markets.

Cotton gins are located in many towns, and a cottonseed-oil mill and cotton compress are at McKinney. Cotton is sold to local buyers and shipped to the various manufacturing centers of the world. Wheat is shipped to milling centers, and some is used by a flour mill in McKinney. Oats, corn, and other feed crops are consumed largely on the farm where grown, but various grains are at times sold for shipment to outside points.

In recent years, much interest has developed in the commercial production of onions, and local reports state that 200 carloads were shipped in 1930.

A number of small commercial dairies and poultry-raising plants supply local markets and ship some products. Some farmers specialize in raising Jersey cattle, most of which are sold locally and some shipped to buyers in Oklahoma. A few farmers feed and fatten small numbers of beef cattle, and, as this industry is believed to have a promising future, it is being encouraged.

Table 2 gives the acreage and yield of the leading crops as reported by the Federal census at 10-year intervals, from 1879 to 1929, inclusive.

TABLE 2.—*Acreage and yield of the principal crops in Collin County, Tex., in stated years*

Year	Cotton		Corn		Oats		Hay		Wheat	
	Acres	*Bales*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Tons*	*Acres*	*Bushels*
1879	48,236	22,145	52,255	1,016,140	10,834	338,419	2,674	2,430	24,242	188,702
1889	86,903	37,094	64,983	2,176,223	20,214	678,819	6,832	9,989	24,555	309,601
1899	119,451	50,762	123,705	5,151,160	47,985	2,012,130	5,030	8,259	82,469	1,454,450
1909	164,956	56,255	145,656	2,739,127	27,068	658,034	12,160	11,311	15,082	180,890
1919	176,901	49,311	73,258	2,574,689	47,048	1,647,100	17,735	28,144	63,261	950,360
1929	218,519	70,464	76,727	1,620,105	31,115	815,690	17,911	20,379	31,270	406,383

Cotton has been the leading crop since about 1885, and the acreage has rapidly increased, but the acreage of other crops has fluctuated greatly from year to year. In 1929 the acreage devoted to cotton amounted to nearly 54 percent of all the crop land.

Some of the increased acreage in hay is owing to encroachment of Johnson grass which has been allowed to grow in some fields formerly in cultivation.

In 1929, barley was grown on 575 acres, potatoes on 347 acres, sweetpotatoes on 134 acres, and onions on 1,349 acres. Bermuda onions were first grown commercially about 1923.

Small orchards, mainly of peaches, plums, and pears, are maintained for home use.

In 1930 there were 18,671 horses and mules, 18,783 cattle, 15,040 hogs, 270,333 chickens, and 12,089 sheep on the farms. The value of field and orchard crops, vegetables, and farm garden crops produced in 1929 was $10,216,000. In that year, the dairy products sold amounted to $310,969, and chickens and eggs sold amounted to $372,683. Vegetables (mostly onions) were harvested for sale from a total of 1,501 acres, yielding crops amounting to $154,356 in value.

Commercial fertilizers are not generally used, as their use here has not as yet been proved generally profitable. The 1930 census reports only 12 farms reporting the use of fertilizer in 1929, at a total cost of $768.

Farm labor is plentiful and can be obtained for $1.50 a day, or from $30 to $40 a month, without board. Where board is furnished the customary wage is about $25 a month. Cotton was picked for 65 or 75 cents a hundred pounds during the 1930 season. Some of the farm laborers are colored, but most of them are white.

In 1880 the census reported 3,629 farms with an average size of 103 acres, and the 1930 census reported 6,069 farms averaging 82.8 acres each. The majority of farms range in size from 50 to 250 acres. A few large landholdings include from 500 to 1,000 acres, but these are usually subdivided into small farms operated by tenants. Land used for crops comprises 72.2 percent of all the land in the county.

A very large proportion of the land is farmed by tenants. In 1879, 54.6 percent of the farms were operated by owners and 45.4 percent by tenants, but in 1929 the tenant-operated farms had increased to 71.7 percent.

The farms are leased almost exclusively on the share basis, whereby the tenant furnishes all labor and expense of growing the crop and delivers one-third of the grain and one-fourth of the cotton produced to the owner for the use of the land. A small number of farms are operated on the half-and-half basis, whereby the owner furnishes land, livestock, implements, and seed and receives one-half of all crops.

The farm buildings, consisting mainly of substantial residences and small barns, are kept in good repair. Most of the farm machinery is of improved types, and tractors supply the power to operate machinery on many farms. However, the use of horses and mules is general, and most tillage and harvesting machinery is still operated by this power. The principal work animal is the mule. Most of the cattle are of the dairy type and the Jersey breed predominates, many herds being purebred.

SOILS AND CROPS

Collin County lies entirely within the Black-land Prairies, a large belt of dark-colored soils, ranging from 20 to 70 miles in width, extending southwestward from near Red River in northeastern Texas to the vicinity of San Antonio. This body of comparatively uniform prairie land is typically characterized in this county by soils of heavy texture. Houston black clay, the dominant soil of the region, by reason of its very dark color and waxy tenacious clay topsoil, has led to the use of the expression " black waxy prairie land " for the black-land soils generally.

The soils have been developed from highly calcareous unconsolidated beds of marl and chalk, which, except on the steeper slopes, lie buried deeply beneath the thick surface soil and subsoil layers. These formations weather rapidly into light-colored stiff waxy clay which, as development progresses, accumulates organic matter and becomes dark.

Because of the large areas of deep rich soils, smooth surface, and favorable climate, the land here is highly suited to farming, and long ago this became one of the most intensively farmed sections of Texas.

The soils, generally, are so similar in texture throughout all parts of the county that differences in suitability to crops lie principally in the degrees of productiveness. The differences in productiveness are largely proportional to differences in thicknesses of the surface soil and subsoil layers, and these have been variously affected and influenced in their development by erosion. Most of the smoothly rolling upland prairie is occupied by deep dark-colored soils which are highly productive and well suited to many crops, chief of which are cotton, corn, wheat, oats, hay (wild grasses and small grains), and sorghums (both for grain and for fodder). The main crop grown is cotton, and this and the other crops requiring clean tillage provide conditions favoring rapid soil erosion. The prevalence of erosion is well illustrated in the many deeply cut small valleys bordered by slopes of thin soils from which, even long before the era of farming had destroyed the protective cover of natural grasses, had been removed the rich dark topsoil material now so deeply accumulated in the narrow flood plains of the valleys. Therefore, the question of agricultural use of the soils devolves largely on their productive capacity and the degree of soil erosion.

The soils may be divided into three general divisions as follows: Deep upland soils, shallow upland soils, and alluvial soils. This grouping is made for convenience in discussing the relative agricultural values of the soils and is not based on soil characteristics. The scientific differentiation of the soils on that basis is discussed in the section of this report entitled " Soils and Their Interpretation."

All the soils are suited to, and used more or less extensively for, most of the crops commonly grown throughout this general area, the proportional acreage of certain crops on particular soils depending largely on the productiveness of the soil and on the available moisture supply.

Cotton, the dominant crop, is the center of most of the agricultural activity. It is a deep-rooted plant well suited to all the soils, but it grows best and yields highest on the deep upland soils and on the

alluvial soils. It thrives best on these soils, not only because of the larger supply of available plant nutrients, but because the available moisture supply is adequate for its needs, although the cotton plant adapts itself to less favorable conditions and will make some growth and production on the less productive shallow soils, except in very dry seasons. Hence, cotton is grown on the shallow upland soils in many places, although the grower realizes that yields will be low, and possibly very unsatisfactory returns will be obtained, considering the effort and time expended on such marginal soils.

On the other hand, corn, also a deep-rooted plant with a large root system, is less adaptable than cotton to unfavorable conditions. It requires abundant water at all seasons and does best on soils containing a large amount of available moisture as well as a high content of nitrogen and other plant nutrients. Therefore, corn does best on the deep alluvial soils which, as a rule, contain a comparatively large amount of available plant nutrients and water. Some corn is grown on the deep upland soils, but moisture is sometimes deficient at the critical period of its growth, and the yield is curtailed.

Alfalfa, much like corn in soil and moisture requirements, does best on the alluvial soils in such places as are not subject to very slow drainage. Neither corn nor alfalfa can be considered a profitable crop on most areas of the shallow soils.

The sorghums are grown more for fodder than for grain, and these crops produce some yields on very thin soils, even under conditions of adverse moisture supply, and, although the sorghums grow best and produce high yields on the alluvial soils and deep upland soils, they make some growth on the thin soils and, as a rule, make a more satisfactory economic return on such soils than do cotton or corn. In addition, sorgo, when sown on the thin soils for a hay crop, provides better protection from soil erosion than do the intertilled row crops.

Oats and wheat are grown to some extent, the acreage devoted to wheat fluctuating largely in proportion to the prices paid for this and other cash crops. The deep upland soils are well suited to both wheat and oats, but the alluvial soils tend to produce a too rank growth of stalk and are not used largely for these crops. The shallow soils, though suited texturally to the production of wheat and oats, contain insufficient quantities of available plant nutrients to produce high yields, and, at times, they contain too little available soil moisture for best growth, though these crops have the advantage of winter and spring moisture. However, oats are grown to considerable extent on the shallow soils, as this crop affords valuable grazing and some grain, in many years sufficient to provide more profitable returns than cotton or corn. Oats also have the added value of protecting the soil from erosion to a greater degree than the cultivated crops. Pasture grasses provide grazing and also prevent excessive erosion.

The deep upland soils occupy smoothly undulating or gently rolling areas and for the most part are drained rapidly, especially when planted to tilled crops. As a rule, rainfall is sufficient and ample water is stored for the use of most crops, though occasional periods of summer drought cause corn to suffer. Though the heavy texture of both topsoils and subsoils results in slow absorption of water, the soil materials are very permeable to water, air, and plant roots. The heavy clay topsoils dry out rapidly in warm weather, and, if cul-

tivated in a slightly moist condition, break down to a loose granular mass, and a loamy tilth is readily maintained by tillage throughout the growing season. Therefore, these soils are highly suited to all the crops commonly grown and ordinarily contain sufficient moisture for excellent growth and moderately high production.

The shallow upland soils occur mainly on fairly steep slopes. They are excessively drained and owe their shallow condition to severe washing during rains. These soils comprise 24.9 percent of the total land area, and, under present conditions and methods of farming, are increasing in extent. These soils not only are comparatively low in available plant nutrients, but, because of the rapid run-off of rain water, store less moisture than the deep upland soils or the alluvial soils. They are better suited to grass, oats, and other sowed crops, such as sorgo, as these crops minimize run-off, thereby preventing excessive erosion, and they often produce more satisfactory yields than cotton or corn. Plate 1, *A* shows native pecan trees growing on a well-drained area of Lewisville clay, eroded phase.

Most of the alluvial soils have, at one time or another, been in cultivation, the principal crops being cotton and corn. These soils are highly productive, but occasional wet seasons or overflows cause losses or conditions unfavorable to crop growth. These soils are well suited to all crops except the small grains. They are especially suited to corn, and, where very well drained, to alfalfa and to pecan trees. Owing to the encroachment of Johnson grass, a large part of the alluvial soils is now used for pasture and hay crops.

In the following pages is a detailed discussion of the different soils, with special reference to their relations to one another and to the agriculture of the county. Their location and distribution are shown on the accompanying soil map, and table 3 gives their acreage and proportionate extent.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Collin County, Tex.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Houston black clay	236,864	42.2	Houston black clay, shallow phase	1,600	0.3
Houston black clay, flat phase	16,000	2.8	Houston clay, shallow phase	29,568	5.3
Houston black clay, colluvial phase	8,128	1.5	Houston clay, gray phase	41,984	7.5
Houston clay	18,432	3.3	Sumter clay	45,312	8.1
Bell clay	27,200	4.8	Lewisville clay, eroded phase	10,752	1.9
Bell clay, high-terrace phase	16,320	2.9	Chalk (Houston material)	10,304	1.8
Lewisville clay	768	.1	Trinity clay	40,512	7.2
Wilson clay	22,720	4.0	Catalpa clay	28,672	5.1
Wilson clay loam	6,080	1.1			
Crockett very fine sandy loam	704	.1	Total	561,920	

DEEP UPLAND SOILS

The soils included in the group of deep upland soils are members of the Houston, Wilson, Bell, Lewisville, and Crockett series. These soils occupy 62.8 percent of the county and are the most extensive and among the most productive soils. They are used successfully for all the crops commonly grown, though cotton is grown most extensively. They are developed on smoother less severely eroded areas and where protected from erosion remain highly productive for a long time.

Owing to outstanding differences in structure, which are reflected in susceptibility to cultivation, the soils of this group are placed in two subgroups—one consisting of Houston, Bell, and Lewisville soils which are rich in calcium carbonate and which, being of granular structure, are readily cultivated and maintained in good tilth; and the other, of the Wilson and Crockett soils which are characterized by a low content of calcium carbonate and a decided tendency to bake into a hard structureless mass on drying, thus causing difficulty in cultivation. Soils of the Houston (granular) group, and of the Wilson (tight) group are highly productive and are well suited to the several crops successfully grown throughout the county. The deep upland soils are very extensively cultivated—probably not less than 85 percent being devoted to crops. These soils are not only inherently highly productive but are strong, and, where ordinary methods of soil conservation and improvement are employed, they are capable of long-sustained crop production with apparently little or no diminution of yields. Methods which have proved valuable in prolonging the productiveness of these soils are terracing to prevent or reduce erosion, incorporation of organic matter, and crop rotation. However, these practices, though employed by some farmers, are not, as yet, universally used.

Houston black clay.—Houston black clay is by far the most extensive soil, and it occupies the greater part of the extensive belt of Black-land Prairie extending through about 30 counties in the State. It occupies 370.1 square miles in Collin County, occurring over large areas of the rolling upland. It has adequate drainage but is susceptible to erosion, and, from the steeper slopes, especially where tilled crops are grown, a large amount of soil is washed away during rains. Originally covered with a heavy prairie growth of bluestem, grama, and some short grasses, the soil was largely protected from severe erosion, and the grasses yearly added a large supply of organic matter. This soil, which is still highly productive over large areas, has been the chief contributing factor to the development of a highly prosperous agricultural section that is the most thickly settled and most intensively farmed of any natural region of the State.

The topsoil of Houston black clay ranges in color from very dark gray or very dark brown to black. It consists of calcareous granular clay, from 10 to 14 inches thick, grading below into dark-gray calcareous clay which, at a depth ranging from 3 to 4 feet, is underlain by gray or yellow calcareous clay, this material, in turn, grading below, at a depth between 5 and 6 feet, into the parent marl or chalk. The topsoil contains a fairly large amount of thoroughly decomposed organic matter derived originally from the decay of grass roots and maintained more or less efficiently by incorporation of crop residues. The soil is highly granular and on drying separates into fine grains, but when wet it is extremely tenacious, giving rise to the well-known name "black waxy land." It cannot be cultivated when wet, on account of its adhesive qualities, but when moist it is worked readily with tillage implements and, though the material breaks into clods, these, on exposure to air and rain, quickly crumble to a pulverulent granular mass.

During long, dry, hot seasons the soil cracks deeply, although, in cultivated fields, this tendency is largely prevented by tillage. Soil

cracking is prevalent where the land is uncultivated, and it is probably responsible for the formation of the numerous regular inequalities covering the virgin prairies, which, locally called "hog wallows", led to the use of the term "hog-wallow land", also applied to this soil. With cultivation the hog wallows disappear, though in very long periods of hot, dry weather some cracks form, even in cultivated fields.

The surface soil and subsoil, as well as the parent material, are readily penetrated by water, and ordinarily a large supply of available moisture is held in reserve for growing crops. The surface soil and subsoil material, by reason of their granular structure, allow ready access of moisture, air, and plant roots, and they provide a large range of spread for the feeding root system of plants. Owing to the ready penetration of roots, plants early develop a deep root system which enables them to withstand the hot, dry weather of summer, at which period rainfall is sometimes inadequate for the best growth and production of crops.

Houston black clay is normally the most productive upland soil of the county. Because of its heavy texture it is better suited to cereal crops and cotton than to vegetables or fruits, though, with care, some vegetable and fruit crops are produced satisfactorily. The principal crops grown are cotton, corn, wheat, oats, sorghums, and hay, of which cotton, owing to its ready sale for cash, is by far the leading crop, occupying more than half the crop land. Some farmers plant nearly all their crop land to cotton, whereas others grow some wheat or oats.

Where cultivated many years to the same crop, the soil responds well to the application of organic matter and decomposed manures and to the growth of legume crops, such as sweetclover, but thus far the application of commercial fertilizers has not been proved to be generally profitable.

This soil is susceptible to damaging erosion in cultivated fields, but on the smoother areas, where washing is uniform and gradual, the injury has not as yet been fully realized by many farmers. In recent years, however, some have realized that the gradual diminution in crop yields is largely attributable to this soil loss, and much of the land is being terraced to reduce erosion and also to hold the water until it sinks into the soil mass, where it is held in reserve for the use of growing crops.

Crop yields on Houston black clay are ordinarily high, though the average yields differ considerably from year to year, owing to seasonal variations in the moisture supply, and differences occur on different farms, depending on care in farming practices and methods employed in conserving the inherent productiveness of the soil. Crop yields, taken from reports of local farmers, are as follows: Cotton yields range from about one-third to 1 bale an acre, the latter amount not being ordinarily obtained. Corn, which ranks next in acreage, has a wider fluctuation, acre yields ranging from 20 to 50 bushels, the lower yield often being caused by a short spell of hot, dry weather in early summer at a critical period in the growth of the crop. Oats are grown on comparatively small acreages, and yields range from 35 to as high as 90 bushels an acre, depending on the supply of available moisture. Wheat has been grown more extensively, the acreage

changing from year to year according to the selling price. Yields range from 12 to 35 bushels an acre, depending on the seasonal moisture conditions. A few small fields of alfalfa have been grown successfully, yielding from 2 to 4 tons an acre a season. This soil is well suited to this crop, but the supply of soil moisture in many summers is insufficient. Sudan grass grows well, and high yields of hay are obtained, in addition to the valuable grazing afforded, but little is as yet grown. The grain sorghums do well, milo and hegari yielding from 15 to 35 bushels of grain and a large quantity of forage.

Some onions have been grown commercially, yields ranging from 75 to 100 bushels an acre. A small acreage is devoted to garlic, with a yield of about 1,500 pounds an acre; also to barley, which yields from 20 to 30 bushels an acre. Hay crops are harvested from small fields of wild or introduced grasses, the chief of the last-mentioned being Johnson grass, which is difficult to eradicate from cultivated fields but which grows rankly on this soil.

Cotton root rot, a fungus disease, is especially injurious to cotton on this soil and destroys much of the crop. It is more prevalent during the warmer part of the season. As this disease causes great losses to cotton farmers, it has become the subject of wide investigation by Federal and State specialists (*7*).

Houston black clay, flat phase.—Small areas of soil on smooth nearly flat surfaces of Houston black clay are differentiated as Houston black clay, flat phase. This soil is similar to the typical soil, with the exception that it is thicker, the black topsoil in the flat phase being about 18 inches thick. Owing to the smooth flat surface, this soil is not subject to so much erosion as the typical soil. Surface drainage is slow, and, though it is entirely adequate for successful cultivation, a rainy spring may cause conditions hindering early growth of row crops, such as corn and cotton. The same crops are grown and it is said that yields are approximately the same as on the typical soil, with slightly higher yields of wheat and oats but somewhat lower yields of corn in areas having especially slow drainage.

Houston black clay, colluvial phase.—At the foot of some slopes of the Houston soils, small areas of smoothly spread outwash soil material are mapped as Houston black clay, colluvial phase. This material has developed into soil nearly identical with the typical soil. The same crops are grown and yields are said to be about the same as on the typical soil, though it is reported that in very dry seasons yields are slightly higher, owing, it is assumed, to a slightly larger supply of available moisture collected both by run-off and by seepage from the higher adjacent slopes.

Houston clay.—Houston clay, a soil of slight extent in the western part of the county, differs from Houston black clay chiefly in having a less dark topsoil and thinner subsoil layers above less deeply weathered parent material. It consists of grayish-brown or brown calcareous clay, to a depth ranging from 8 to 15 inches, and grades through a thin transitional layer into brownish-yellow calcareous clay which rests on chalk at a depth ranging from 30 to 40 inches. Like Houston black clay, this soil contains much carbonate of lime and has the same highly granular physical structure, enabling ready cultivation and a friable loose seed bed. The layers are similarly

permeable and absorb water as readily in positions of equal gradient, but, owing to the generally sloping surface and thinner subsoil layer, the soil is not so favorably situated to collect and store such a large amount of water as Houston black clay. It also is inherently slightly less productive and in most places contains a smaller amount of organic matter.

This soil is very productive and is practically all in cultivation, the principal crop grown being cotton, with much smaller amounts of corn, oats, and wheat. It is well suited to these crops and, according to local authorities, yields are but slightly below those on Houston black clay. Cotton is often affected by root rot on this soil.

Included with this soil south of Celina are two areas of Ellis clay which were too small to indicate separately on the soil map. This included soil is brown or olive-drab noncalcareous heavy clay resting, at a depth of 10 inches, on gray waxy clay containing particles of gypsum, and this, at a depth ranging from 24 to 36 inches, is underlain by bluish-gray shale. This soil resembles Houston clay on the surface, but it is less productive and crops on it are less resistant to seasonal moisture deficiencies.

Bell clay.—Bell clay is a black heavy calcareous soil very similar to Houston black clay in its chief characteristics. It is not of great total extent, though several large areas are in different sections on flat or nearly flat old stream terraces underlain by beds of gravel. The largest bodies occur along East Fork Trinity River, in the vicinity of McKinney, and along Honey and Wilson Creeks.

The topsoil of Bell clay is black calcareous clay about 12 inches thick. It grades below into dark-gray calcareous clay which, between depths of 30 and 40 inches, grades into yellow clay, and this, in turn, passes, at a depth of about 4 feet, into mottled yellow and gray calcareous clay which, at a depth ranging from 5 to 10 feet, rests on a bed of sand and rounded gravel. The topsoil contains considerable calcium carbonate and organic matter, and the granular structure of this and the subsoil layers is very similar to that of the corresponding layers of Houston black clay. Areas of this soil are, in general, nearly flat, erosion is less prevalent, and underdrainage, owing to the gravel substratum, is more free than beneath Houston black clay.

Practically all the land is cultivated. Its suitability to crops and its productiveness are similar to Houston black clay, the same general crops being grown and yields being practically the same as on that soil. Although in places root rot injures cotton on Bell clay, it is noted that in some years some areas are free of the diseased plants, and the disease is not so prevalent as on Houston black clay.

Bell clay, high-terrace phase.—In places where Bell clay occupies very high terrace positions, it is indicated on the soil map as Bell clay, high-terrace phase. Soil and crop conditions are here about the same as on the lower terraces. The largest areas are along the western boundary of the county between Celina and Frisco.

Lewisville clay.—Lewisville clay is a brown calcareous soil of slight extent, which occurs in a number of widely separated small areas on terraces, in association with Bell clay. This soil is very similar in color, texture, and physical structure to Houston clay. The 8- to 15-inch surface soil of the Lewisville soil consists of dark-

brown calcareous clay. It grades below into brown calcareous clay which is less dark than the topsoil but is similar in texture and structure. At a depth ranging from 18 to 30 inches, this material passes into yellow clay which, between depths of 4 and 10 feet, is underlain by a bed of rounded gravel.

In location and manner of development this soil is closely related to Bell clay, but it is less dark, owing to a smaller content of organic matter. The land is undulating or nearly flat and has comparatively free underdrainage.

The soil is highly productive and is well suited to the same crops as those grown on Bell clay. All the land is in cultivation, cotton and corn being the principal crops grown. Yields are reported as ranging from about one-third to three-fourths of a bale of cotton and from 25 to 50 bushels of corn an acre. Cotton root rot is exceptionally destructive on this soil.

Wilson clay.—Wilson clay, though belonging to the dark-soil group, is representative of soils of the tight-soil group, that in places comprise rather extensive areas of the Black-land Prairie. In this county it is not of great extent, though some areas occur in the northwestern and northeastern corners and in the southeastern corner in the vicinity of Josephine.

Wilson clay is a dark-gray dense clay grading, at a depth of about 10 inches, into gray heavy clay which, below a depth ranging from 18 to 24 inches, contains a few small concretions of calcium carbonate, though the fine earth, as in the layers above, shows no response with tests made with hydrochloric acid. Below a depth ranging from 40 to 48 inches, the material is yellowish-gray slightly calcareous clay containing small white concretions and glistening particles of gypsum. This material rests on gray chalky marl at a depth ranging from 4 to 5 feet beneath the surface. The surface soil and upper subsoil layers are characterized by dense stiff clay containing no calcium carbonate, so far as could be determined by field tests.

The structure of the clay is dense and plastic when wet, and on drying it becomes extremely hard and tough. On drying after rains a tight crust forms on the surface, which prevents or hinders germinating seed from pushing the young shoots to the surface. The granular structure which characterizes the Houston soils is not present, and, therefore, cultivation is difficult and cannot be accomplished except at just the right stage of moisture content. If cultivated at the proper time the soil works to a coarse-granular or fine-cloddy mass. This soil is known locally as "tight land" or "rawhide land." In places small light-colored spots occur, known as "slick spots", where vegetal growth is hindered, not only by the very unfavorable structure, which renders penetration of plant roots, air, and moisture difficult, but also by an excess of accumulated soluble salts which probably consist largely of sodium chloride.

Wilson clay occupies nearly flat areas where surface drainage is practically lacking and where, owing to the difficulty of water passing downward through the dense surface soil and subsoil, underdrainage is imperfect.

Most of the land is in cultivation, and probably 75 percent of it is planted to cotton. Although difficult to cultivate, it is moderately

productive and fairly well suited to small grains and cotton and to less extent to corn. Local farmers report that acre yields of oats range from 25 to 65 bushels; wheat, from 10 to 25 bushels; cotton, from one-fourth to one-half bale; and corn, from 20 to 40 bushels. The soil is suited to grasses and sorghums.

Doubtless the intractability of this soil could be overcome to considerable extent by the incorporation of vegetable matter, either by plowing under green crops and crop residues or by applying decomposed organic manures and vegetation.

Wilson clay loam.—Wilson clay loam is much like Wilson clay, except that the clay loam topsoil is not quite so heavy as that of the clay.

The 6- to 12-inch surface soil of Wilson clay loam consists of dark-gray or blackish-gray clay loam. This material grades into heavy tough dark-gray clay which, below a depth ranging from 24 to 30 inches, contains concretions of calcium carbonate, though the fine-earth material, as in the layers above, is not calcareous. Below a depth ranging from 40 to 50 inches, the clay is calcareous and passes gradually into gray and yellow mottled marl. In places the surface is covered with a layer of fine sandy loam, 1 or 2 inches thick. The topsoil of Wilson clay loam, although less intractable than that of Wilson clay, is difficult to cultivate, as it dries to a hard structureless mass, giving rise to the local name of "tight land." The topsoil and upper subsoil layer seem to be free of calcium carbonate, and the organic-matter content is low.

The soil is of slight extent. It occupies small areas in the eastern part of the county, the largest occurring in the vicinities of Pike and Snow Hill. As mapped, small areas of Wilson very fine sandy loam are included.

The surface relief is flat or gently undulating, and surface drainage is moderately rapid, but underdrainage is slow. Nearly all the land is cultivated and is fairly well suited to the general farm crops, cotton being the most important. Local farmers state that crop yields are about the same or slightly lower than on Wilson clay. Some farmers report that blackberries and dewberries generally do better on Wilson clay loam than on the other soils. One farmer using 8 tons of manure an acre for potatoes obtained a yield of 90 bushels an acre on this soil.

Crockett very fine sandy loam.—Crockett very fine sandy loam is a claypan soil, in most places occurring in association with the Wilson soils, generally, though not invariably, with the moderately sandy types. It has developed from material similar to that from which the Wilson soils have developed, but, in general, from the sandy phases of that material. Dominantly the material is faintly calcareous clay containing some very fine sand, and, in its development by the prevailing weakly expressed podzolic process, the surface soil becomes eluviated into brown sandy material with a very fine sandy loam texture by the removal, in most places by downward transfer, of the clay. The clay thus removed is accumulated in the soil layer, at a depth ranging from 6 inches to a foot or more, on the original clay material, the considerably increased content of clay converting it into a heavy clay or claypan layer, the transition from the sandy surface layer being generally abrupt. The claypan

layer is heavy, but as a claypan it is definitely though moderately developed. This layer reaches a maximum of about a foot in thickness and changes downward into the parent clays which are somewhat lighter in texture and, at a depth of several feet, are faintly calcareous.

This soil occurs in a few small areas only, all within a distance of about 5 miles northeast of Farmersville. They are associated with Wilson clay loam and with Sumter clay, the latter consisting essentially of the material from which the Crockett and Wilson soils have developed, with practically no covering of soil, that having been removed by erosion.

Crockett very fine sandy loam is somewhat less productive than Wilson clay loam. The sandy surface soil contains smaller percentages of nitrogen and mineral elements of plant nutrients than the corresponding layer of the Wilson soil, and the sandy surface texture, together with the claypan, renders this soil somewhat more droughty than the Wilson soil.

This soil is used for the same crops as the Wilson soils, but, as a whole, a smaller proportion of its total area is utilized for cultivated crops, and a larger part is in pasture. It is, however, naturally a less productive soil for grass than the Wilson soils, and virgin areas are largely occupied by brush.

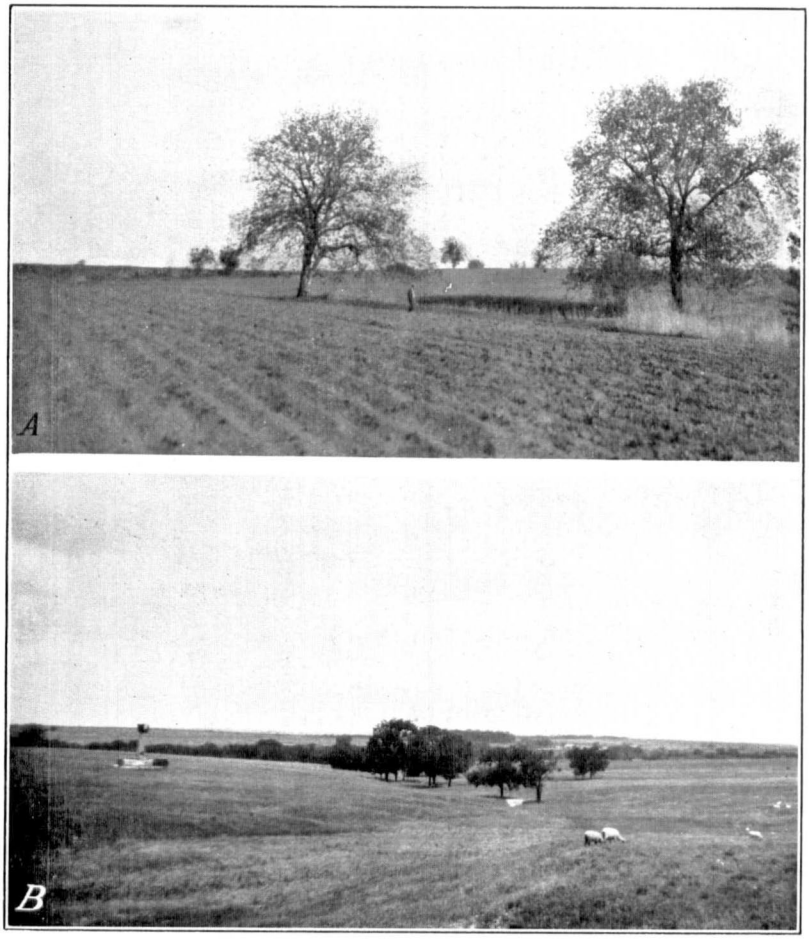
SHALLOW UPLAND SOILS

The group of shallow upland soils includes small scattered areas of soils (mainly soil phases) of the Houston, Sumter, and Lewisville series. These soils aggregate a total of 139,520 acres, or 24.9 percent of the land in the county. They occupy the steeper slopes and are subject to erosion. In fact they owe their origin to the washing away of soil layers which, if left in place undisturbed sufficiently long, will develop into the deep upland soils.

These shallow soils are inherently rather low in productiveness and in capacity for collecting and retaining moisture. They range in productive capacity from practically nothing for the chalk (Houston material) to moderate for the less shallow and comparatively less eroded soils which, in some seasons, produce moderate yields of some crops. Because these comparatively thin soils occur in many places in small spots surrounded by the deep soils they are cultivated with the better soils, as their exclusion from the general scheme of field arrangement would be very inconvenient; but where they occur in larger areas they are more often planted to oats, sorghums, or other feed crops or are left in the native grasses for pasture. These crops, which are grown to a rather large extent on some of the soils, probably produce more profitably than cotton, corn, or wheat.

These soils occur mainly on ridges and slopes, the largest areas being along Wilson, Honey, and Indian Creeks and on the White Rock Escarpment in the western part of the county. It is better to keep some of the areas in grasses than to cultivate them. Terracing would lessen erosion, and productiveness would be increased by adding organic matter.

Houston black clay, shallow phase.—Houston black clay, shallow phase, in the upper layers is similar to typical Houston black clay, but it differs from that soil in that these layers are thinner and chalk



A, Native pecan trees on Lewisville clay, eroded phase. *B*, Buffalo-grass pasture on Houston clay, shallow phase

lies nearer the surface. The surface soil of this shallow soil consists of black calcareous clay from 6 to 10 inches thick, containing some fine fragments of chalk, and it is underlain by a subsoil of dark-gray calcareous clay which, at a depth ranging from 10 to 24 inches, rests on hard white chalk.

This soil occurs in small areas in the western part of the county, the largest body lying northeast of Allen.

As it is texturally and structurally identical with typical Houston black clay the soil is easily cultivated, but, owing to its thin surface soil, it affords a restricted feeding zone for plant roots and for the storage of moisture. It is suited to the same crops as the typical soil, but yields are generally lower. It occurs on ridges and slopes and is subject to erosion. It is better suited to shallow-rooted crops, such as oats and wheat, than to cotton or corn, as the last-named crops do not obtain sufficient moisture during the summer in the shallow soil.

Houston clay, shallow phase.—Houston clay, shallow phase, occurs in a few large and many widely separated small areas throughout the western part of the county, the largest comprising a considerable part of White Rock Escarpment. This soil is similar to typical Houston clay in texture and structure, but, owing to erosion, the surface soil and subsoil layers are very thin. The 4-inch surface soil of brown or grayish-brown calcareous granular clay overlies pale yellowish-brown chalky highly calcareous clay which rests, at a depth ranging from 10 to 15 inches, on soft chalk. This soil occurs on fairly steep slopes and is excessively drained and washed.

Only about one-half of the land is in cultivation, as its limited capacity for production is well known. Though all the common crops are grown to some extent, cotton is planted on about 20 percent of the crop land, corn on about 10 percent, wheat on about 40 percent, and oats on about 30 percent. Cotton yields range from failure to one-fifth bale an acre, corn from 10 to 25 bushels, oats from 20 to 40 bushels, and wheat from 10 to 18 bushels. About half the land remains in pasture composed of a moderately thick growth of native grasses (pl. 1, *B*). The soil seems better suited to grasses and small grains, as these crops make a growth before the moisture accumulated during the winter and spring has been dissipated by the heat of summer.

Houston clay, gray phase.—Houston clay, gray phase, is an eroded light-colored soil occurring in many small spots on slopes and ridges throughout the northern and western parts of the county, surrounded by the deeper soils. The 4- to 10-inch surface soil is ash-gray highly calcareous granular clay. It is underlain by light-colored ash-gray calcareous chalky clay resting, at a depth ranging from 15 to 24 inches, on chalk. The surface soil contains little organic matter, is very calcareous, and is of granular structure. The land, where unprotected, is subject to severe erosion. It is not highly productive and seemingly is best suited to pasture grasses, hay crops, and oats. About 30 percent of it is cultivated, oats and wheat being the chief crops, but small quantities of cotton and corn are grown. Much of this soil occurs in fields composed largely of more extensive highly productive soils, and crop yields, by comparison, are lower

than are considered profitable for general farming. Estimated acre yields of oats range from 15 to 30 bushels, wheat from 8 to 15 bushels, and cotton produces as high as one-sixth of a bale.

This soil, like all the other shallow upland soils, would be improved by terracing to reduce surface wash and by a generous incorporation of organic matter.

Sumter clay.—Sumter clay occurs in a number of scattered small areas throughout the eastern part of the county, the largest being in the vicinity of Farmersville. This soil constitutes areas of very severely washed Houston soils occupying moderate or steep slopes. Small areas of Houston clay and Houston black clay are included with this soil in mapping.

Sumter clay consists of yellowish-brown or grayish-brown calcareous granular clay from 2 to 7 inches thick, underlain by brownish-yellow or greenish-yellow calcareous clay which, at a depth ranging from 18 to 30 inches, grades below into yellow and gray mottled marl.

Because of its shallowness and occurrence on slopes, this soil is of low productiveness and in many places retains only a small reserve of available moisture for growing crops. The soil is granular and easily cultivated, but it is low in organic matter. The large areas comprising much of the steeper and gullied slopes are left in native grasses for pasture, though many small spots are cultivated in conjunction with the larger bodies of deep soils surrounding them. Perhaps 40 percent of the land is cultivated, mostly to cotton and a little corn. Estimated acre yields range from about one-tenth to one-fourth of a bale of cotton and from 10 to 30 bushels of corn.

Lewisville clay, eroded phase.—Lewisville clay, eroded phase, occurs on severely washed slopes of smooth terrace lands, which are occupied chiefly by Bell clay and Lewisville clay in the less sloping situations. The areas are small and scattered, the largest being near Clearlake and McKinney.

This soil has a thin topsoil of brown or yellowish-brown friable granular calcareous clay from 2 to 6 inches thick, which is low in organic matter. This material is underlain by yellowish-brown or brownish-yellow calcareous crumbly clay which, at a depth ranging from 4 to 10 feet, rests on a bed of sand and rounded gravel or alternating layers of these materials.

This soil represents washed areas of Lewisville clay, from which the topsoil has been largely removed. Probably not more than 40 percent of the land is cultivated, the rest being in pasture. This soil is not highly productive, and the areas in cultivation, mainly within fields composed largely of deep soils, are estimated to yield from one-fifth to one-third of a bale of cotton and from 15 to 30 bushels of corn an acre.

This soil should be protected from erosion, and organic matter is needed to make it more productive. It is probably better suited to grasses and sowed grain crops than to crops requiring frequent tillage.

Chalk (Houston material).—The white chalk formation underlying the soils throughout the western part of the county is in places completely exposed on the surface or has but a thin cover of gray calcareous clay loam, from 2 to 6 inches thick, containing fragments of the chalk. The areas of this chalk are associated with small

spots of some of the other shallow soils, and the larger areas shown on the map, such as in the vicinity of Westminster and along the slopes of the valleys of Clemons, Sister Grove, and Pilot Grove Creeks, include unmappable bodies of the slightly deeper soils. Chalk represents an extreme condition of erosion, where no developed soil remains in place.

The land is occupied by a growth of small trees and shrubs, chief of which are small oaks, locally called shin oak, Spanish oak, redbud, hackberry, elm, and sumac. These trees and shrubs, together with a small amount of grasses and herbaceous plants, grow mainly in depressions where a slight amount of soil material has accumulated, though some of the shrubs grow on the bare spots where crevices and cracks filled with fine earth and vegetable debris offer a foothold to the more hardy species. A few small spots, in which the deeper accumulations of soil materials occur, are sometimes planted to cotton or small grains, but crop yields are generally so low that the only value of this land is for the scant pasture afforded by the native vegetation.

ALLUVIAL SOILS

Although widely distributed in narrow flat bottom-land strips along the numerous branches and creeks, the aggregate acreage of these valuable soils is large, amounting to 12.3 percent of the total land area. These soils represent accumulations many feet thick of soil material which has been removed by erosion from the dark calcareous upland soils, transported by water, and deposited in the many shallow valleys cut by the numerous streams of the Black-land Prairie drainage system. Belts of these soils range in width from 100 feet to more than 1 mile.

These soils are members of the Trinity and Catalpa series. They are dark deep calcareous soils rich in organic matter. They are granular and pulverulent, allowing easy cultivation, and are highly productive. Trinity clay and Catalpa clay were identified and mapped. These soils differ very little, except in color, Trinity clay being very dark brown or black and Catalpa clay being brown.

Owing to the low flat surfaces of the areas which lie only a few feet above the stream level, the land is occasionally overflowed in rainy seasons, although, as a rule, the water does not remain long on the land, and it is possible to produce good crops during most seasons without serious injury from overflows or from unfavorable drainage.

Only about one-fifth of the area of the alluvial soils is in cultivation, although local residents state that at one time about 75 percent of this land was farmed. The abandonment of much of the land for cultivated crops is said to be owing largely to the encroachment of Johnson grass following periods of overflow, when conditions were such as to prevent its eradication. This hardy and rapidly growing grass has become a serious pest in many fields, but as it is valuable for pasture and hay, it is a useful crop on some farms.

The native vegetation originally consisted mainly of trees, principally elm, hackberry, ash, bur oak, and some others, and in the better drained locations some pecan trees. The soils are especially suited to corn, alfalfa, and cotton, and they are planted mostly to

cotton, corn, and feed crops, including sorghums. In places, some protection from overflow is afforded by the construction of levees.

Trinity clay.—Trinity clay, the principal alluvial soil along most of the streams of the Black-land Prairie, occurs in many valleys of Collin County. It consists of black or dark-brown calcareous clay to a depth ranging from 8 to 12 inches, where it grades into clay very similar to the topsoil but slightly lighter in color, being dark-gray or dark-brown calcareous crumbly clay many feet thick. The surface soil is granular and works readily into a deep loose seed bed having excellent tilth which is easily maintained by cultivation.

Trinity clay occupies the larger stream valleys, and natural drainage is slow, though in most places it is adequate for most crops. Cotton is the principal crop grown and, under favorable conditions, yields as much as 1 bale an acre. This soil is also excellent for corn which yields from 40 to 60 bushels. The soil collects and holds a large supply of water, and during dry seasons the abundance of available moisture enables crops to continue vigorous growth. In the better drained locations, native pecan trees thrive. Johnson grass grows well and yields from 1 to 2 tons of hay an acre.

Catalpa clay.—Catalpa clay is brown calcareous clay ranging from 5 to 12 inches in thickness, underlain by dark-gray or brown clay to a depth of many feet. It occurs more generally in the narrower valleys along the smaller streams, and for the most part drainage is more favorable for crops than on Trinity clay. In general, a larger proportion of this soil is suited to alfalfa and pecans than of Trinity clay. The same crops—cotton, corn, and feed crops—are grown, and yields are about the same on the two soils. Cotton is rarely affected with root rot on this soil or on well-drained Trinity clay.

AGRICULTURAL METHODS AND MANAGEMENT

The methods of farming in Collin County are such as are commonly practiced on the cotton-producing farms of the Texas prairies. For many years the soils have been planted to cotton without regard to a systematic crop rotation, although many farmers have learned that by occasionally changing the land to different crops increased yields are obtained. The deep rich dark soils have maintained their yields remarkably well, considering the indifferent care given to the protection of the soil from erosion and the general absence of methods designed to conserve soil productivity. The smooth dark soils that are subject to only slight erosion and to which organic matter has been periodically added by the plowing under of vegetable matter, chiefly crop residues, have seemed to suffer little if any diminution in crop yields, although in recent years average yields of cotton have been somewhat lower than during the early period of cultivation of the dark-soil prairies.

Although the reduction of the yearly average yield has produced a general impression that the soils are declining in productivity, it should be remembered that with more complete occupation of the land much of the shallow soils has been placed in cultivation, and that the impetus given to cotton growing by high prices at different times has led to the practice of planting cotton on a considerably larger acreage of the thin shallow soils of comparatively lower productivity than was formerly the practice, when land was

so plentiful that only the most productive deep soils were farmed. These facts should enter into a study of the statistical data relating to yields. Nevertheless, it is a well-established fact that during recent years much soil in Collin County has been seriously injured by erosion, and for this reason crop yields have declined on many farms. This has been general throughout all the Black-land Prairie region, as well as elsewhere, and much attention is being given to this problem by persons interested in the welfare of agriculture. The National and State agencies of research and demonstration are emphasizing the imperative need for protecting soils from such injury (*2*).

Cooperative research work is being done at the black-land experiment stations at Temple, Greenville, and Denton, and results determined there will be directly applicable to soils and conditions prevailing throughout Collin County. Owing to the efforts of the agents of the extension service and others, a campaign has been carried on over the county to encourage the construction of terraces on the sloping fields, in order to prevent excessive soil washing, and terraces have been constructed on many farms in recent years, protecting thousands of acres of land.

Although much of the injury from erosion is effected by sheet erosion, this, if continued, develops into a gullying type which rapidly destroys both surface soil and subsoil, and such a condition requires effective and special methods to prevent great devastation (*5*).

It has also been proved that soil erosion can be at least partly prevented by contour cultivation, by growing crops such as grass or small grains which do not require tillage, by strip cropping (*4*), and by various other practices.

Root rot caused by a fungus, *Phymatotrichum omnivorum*, attacks the roots of cotton, a very susceptible plant, and causes heavy losses in some years. Root rot is especially prevalent on cotton grown on the dark prairie soils. For a reason not yet known, the infestation of cotton by this disease is less prevalent on the alluvial than on the upland soils. Thus far no effective methods of control of the disease have been developed, though a decrease is noted in places where the cotton is grown in a rotation with nonsusceptible crops and clean culture is practiced (*6*).

Crop rotations have proved beneficial to the soil, and yields of crops were increased in a number of experiments made on Bell clay [2] at the experiment station at Temple, this soil having characteristics similar to those of the Houston soils, and it is believed the results are, therefore, generally applicable on the calcareous soils throughout the Black-land Prairie and in Collin County. The results show that the most profitable cropping system is a 3-year rotation including cotton, corn, and oats. This is considered the most practical rotation, as it is possible to include a soil-improvement crop, preferably a legume, planting it as a catch crop after oats.

At the experiment station (substation no. 6) at Denton, a rotation experiment covering 14 years on San Saba clay—a soil very similar to Houston black clay—was carried on with wheat, oats, corn, and

[2] Formerly correlated as Simmons clay.

cotton, planted continuously on the same land and compared with the same crops in a 4-year rotation, in which cowpeas or sweetclover were grown for soil improvement. The rotation with the soil-improvement crop increased the yield of wheat 119 percent; of oats, 66 percent; of corn, 15 percent; and of cotton, 22 percent (*1*).

Commercial fertilizers are not generally used on the soils of Collin County, as experiments with fertilizers on the dark-colored soils have not proved profitable throughout a long period of time, though sometimes excellent results are obtained, but more often the results are indifferent or negative.

As a rule, the farmers recognize the value of good seed, and improved seed, especially of cotton and corn, is generally used. The principal varieties of cotton grown are Mebane, Qualla, Kasch, Truitt, Sunshine, Rowden, and Bennett, all of which are improved types of upland cotton; Surcropper and Reid Yellow Dent corn are commonly grown; Mediterranean and Turkey are the leading varieties of wheat; and Red Rustproof (Red Texas) oats are most satisfactory. Nortex oats and Denton wheat, varieties developed at Texas substation no. 6 at Denton, are reported by farmers to produce excellent yields in Collin County.

SOILS AND THEIR INTERPRETATION

Collin County lies wholly within the Black-land Prairie which constitutes a large body of dark-colored soils that have been developed in a warm moist climate beneath a dense vegetal cover of coarse grasses. Although these soils lie within the humid region, which is characterized by pedalferic soils, the dark-colored prairie soils have characteristics and functions that differ materially from the normal pedalfers which have a well-developed profile arrangement, in which the different horizons or layers are distinctly differentiated by differences in color, texture, structure, and chemical constituents, produced largely by the processes of leaching and eluviation. In general the pedalfers are of acid reaction, have marked impoverishment in the surface horizon, are low in organic matter, and, as a rule, are thoroughly leached of the alkaline bases and of a large amount of the soluble organic and inorganic constituents.

The dark-colored prairie soils covering the county typically represent soils developed from calcareous unconsolidated parent materials in a warm climate with a comparatively high rainfall and are generally known as rendzinas. These soils constitute an aggregate area in Texas of about 11,000,000 acres, of which the main prairie, in which this county is located, comprises a single body of about 9,000,000 acres.

In general these soils are characterized by (1) dark-colored topsoils comparatively high in organic-matter content; (2) dark-colored subsoil layers only slightly lighter in color than the topsoils, with no sharply defined line of demarcation between the layers; (3) dominantly heavy textures; and (4) an alkaline reaction. These soils are further characterized by gradational stages of development owing to erosion, the more youthful soils having a larger content of calcium carbonate and a more highly granular structure than those soils in more advanced stages of development, this feature being consistent

with pedalferic development. Development of the typical pedalferic or podzolic profile into A and B horizons has not taken place.

The dark-colored prairie soils are developed from marl which immediately underlies the surface soil of the eastern part of the county, and from chalk in the western part. These materials are highly calcareous and weather rapidly into calcareous clay which, at first, is light in color, but rapidly becomes dark as soil development progresses. The clay material is granular, contains a large quantity of calcium carbonate, is permeable, and provides ready access to plant roots, air, and water, so that the changes involved in soil development are comparatively rapid. The large quantity of organic matter provided by the heavy growth of coarse grasses accounts for the very dark color of the soils. Owing to their heavy texture and the high percentage of calcium carbonate in the parent chalk and marl and the cover of grass, the soils have not yet become thoroughly leached, although the yearly rainfall is heavy, amounting to 42 inches. The soils are in a youthful stage of development, and they contain much of the geological calcium carbonate. Although the parent material disintegrates rapidly, the high percentage of calcium carbonate in the parent rock and the action of the original grass cover have maintained the soils in an unleached condition, although climatic conditions favor rapid leaching.

On the basis of stage of development and characteristics, the soils of the county fall naturally into three divisions as follows: (1) Calcareous granular soils, (2) noncalcareous tight soils, and (3) alluvial soils.

The calcareous granular soils occupy by far the greater proportion of the uplands, both in Collin County and in the entire Black-land Prairie region. Based on important differences they are separated into the Houston, Bell, Lewisville, and Sumter series. The most highly developed of the granular soils and the most extensive soil of the Black-land Prairies is Houston black clay which occupies large bodies of undulating or gently rolling land.

A typical profile of this soil developed over marl, as observed on a smooth nearly flat ridge 2 miles south of Desert, is as follows:

0 to 14 inches, black calcareous clay which dries and breaks naturally into fine angular grains.

14 to 48 inches, dark-gray granular calcareous clay which contains many fine and small concretions of calcium carbonate.

48 to 60 inches, yellow and gray mottled granular calcareous clay which contains numerous small concretions of calcium carbonate. This layer represents a gradation into marl which, below a depth of 60 inches, is somewhat more gray than the material above.

Cracks, which extend to a depth of several feet, form in the air-dry surface soil, and these, in places, together with animal burrows, wormholes, and root channels, become filled with black soil from above. The surface relief of the virgin soil is characterized by numerous inequalities, called hog wallows, which consist of smoothly rounded humps rising from 1 to 2 feet higher than the depressions they enclose. The humps and depressions are several feet in diameter and are regularly smooth and round on the nearly flat areas, but extend more or less longitudinally down the slopes. Theoretically, the hog wallows are formed by shrinking and cracking of the soil in very dry hot seasons, followed by swelling after extended rains, caus-

ing the soil washed into the cracks to expand and heave upward the mass between the cracks, thereby forming the humps around the depressions in which the cracks had formed. In virgin areas, the humps have only a very thin black topsoil, the clay beneath having a brown or yellowish-brown color, but in the depressions black clay extends to a depth of several feet. The hog wallows disappear after a short period of cultivation, and the dark surface soil gives no indication of profile differences, but in deep cuts the wavelike form of the contact line, dipping and rising between the black topsoil and the brown or yellow subsoil, constitutes a peculiar feature of horizon arrangement.

In virgin areas, the material in the surface layer, on drying, crumbles naturally to a fine-granular thin layer about one-fourth inch thick, the material beneath being hard and compact, though all the material of both the topsoil and subsoil, if exposed to air, forms a granular layer, the granules of the subsoil being somewhat larger than those of the topsoil. In smooth nearly flat areas, where the run-off of rain water is slight, the calcium carbonate content seems, by field test with hydrochloric acid, to be slight in the surface layer, owing to the leaching downward of this constituent. In such places the granular structure is less loose, a slight tendency to crust over on drying is perceptible, and the soil granules adhere somewhat more tightly than in sloping areas. The gray layer (2) is granular, and vertical cracks form on the surface of exposed cuts, causing columnar slabs and segments to separate from the main mass. In the more nearly flat areas these fragments have smooth slick fracture planes. In the more sloping areas, layers 1, 2, and 3 are thinner than in the flat areas, and in places the parent material lies within 2 or 3 feet of the surface. The principal grasses on this and the other granular soils are bluestem, or sedge grass (*Andropogon* sp.), grama (*Bouteloua* sp.), and needlegrass (*Aristida* sp.), and in places some buffalo grass (*Bulbilis dactyloides*), a common short grass of the subhumid plains in the West, which is here known as mesquite grass.

Where developed from chalk, the characteristics of Houston black clay are very similar to those where the soil is developed from marl, but the former seems to be more susceptible to erosion and, therefore, is associated with larger areas of thinly developed soils over the chalk bed which, in many places, lies near the surface.

Following is a description of a profile of Houston black clay developed from chalk, as observed in a smooth area 1 mile south of Allen:

0 to 15 inches, black calcareous granular clay containing fine concretions of calcium carbonate.

15 to 30 inches, grayish-black (very dark gray) calcareous clay containing fine concretions of calcium carbonate.

30 to 40 inches, gray calcareous clay containing fine concretions of calcium carbonate.

40 to 60 inches, light-gray very calcareous chalky soft clay containing slight mottlings of yellow, which increase in number with depth. This material grades below into soft mottled gray and yellow chalky clay which, at a depth of about 6 feet, rests on soft white chalk.

The tight upland soils are included in the Wilson series. These soils apparently are developed mostly from marl containing less lime and more calcium chloride and fine sand than the marl underlying the Houston soils, and, though the topsoils and upper subsoil layers

are free of calcium carbonate, the lower subsoil layers and parent material are calcareous. These soils are developed on flat areas and have imperfect drainage, both on the surface and internally, because of the dense, very slowly permeable subsoils. The topsoils pack tightly on drying and form a dense, hard, structureless mass which is broken apart with difficulty into large irregular clods. Because of the presence in places of "slick spots", showing a large content of soluble salts, the tight nongranular character may possibly be attributed to the fact that soil development is being influenced by salts. Also, it seems probable that these soils have attained more advanced development over long periods of time, during which the calcium carbonate has been leached out, and this, together with other changes in chemical constituents, has affected the dense physical arrangement of the inorganic soil particles. Judging from the low content of calcium carbonate in the upper layers of Houston black clay, flat phase, together with a less granular structure, it might well be assumed that this is a slightly advanced stage in the development of Houston black clay, which, if continued throughout a long period, would eventually evolve the characteristics of the Wilson soils.

A typical profile of Wilson clay, as observed 1½ miles north of Farmersville, is as follows:

0 to 2 inches, gray silty clay loam, in which no calcium carbonate is indicated by test with hydrochloric acid.

2 to 12 inches, blackish-gray (black when moist), dense heavy noncalcareous clay.

12 to 30 inches, dark-gray tough dense noncalcareous clay. The lines of demarcation between this layer and the one above and the one just beneath are difficult to distinguish.

30 to 40 inches, dense dark-gray clay which is noncalcareous but contains a few fine concretions of calcium carbonate.

40 to 48 inches, gray calcareous clay with a slight yellow shade. This material contains fine white concretions of calcium carbonate and glistening yellow fragments of crystalline material which is probably calcium sulphate.

48 to 60 inches, gray chalky marl which is streaked with yellow and contains soft white particles and a few concretions of calcium carbonate. The fine earth is soft, crumbly, and granular. Below this the material is yellow gritty friable marl.

This soil is developed in flat areas. The topsoil on drying forms a hard tight crust that is broken with difficulty into hard small clods which on the immediate surface are rather flat. The exposed profile shows a massive slablike separation of large fragments from the clay subsoil, and these, crossed by irregular smaller cracks, break the material into large hard irregular clods having smooth slick surface planes.

SUMMARY

Collin County is in northeastern Texas. It is almost square and comprises 878 square miles, or 561,920 acres.

Physiographically, the county is a smoothly rolling prairie dissected by numerous shallow valleys. Most of the land is gently undulating and well suited to cultivation. The steep slopes are better suited for pasture, as the surface erodes severely where unprotected.

Transportation facilities are good. Many improved highways have been constructed, and the earth roads are generally kept in good condition but soon become difficult to travel after rains.

The climate is mild and healthful. The mean annual temperature at McKinney is 64.9° F., the mean annual precipitation is 42.24 inches, and the average length of the frost-free season is 229 days.

The agriculture consists mainly of general farming, the principal crops being cotton, corn, oats, wheat, and hay, all of which are grown successfully. The sale of dairy and poultry products provides many farmers with an additional income. Fruit and vegetables are grown for home use by most farmers, and Bermuda onions are grown commercially.

The soils are developed from highly calcareous chalk and marl, and most of them are dark and granular. The principal soil, Houston black clay, occurs in large areas in all sections. Bell clay, Houston clay, Wilson clay, and Wilson clay loam are productive upland soils covering large areas. These soils are all suited to the production of the general farm crops.

The shallow soils are better suited to grasses and small grains than to cotton or corn.

Large areas of Trinity and Catalpa clay occupy first bottoms. They are well suited to the production of cotton, corn, alfalfa, and other feed and hay crops.

Farming in Collin County appears to have a promising future. Dairying and cattle feeding could be greatly increased, as feed crops can be grown successfully on a much larger scale than at present.

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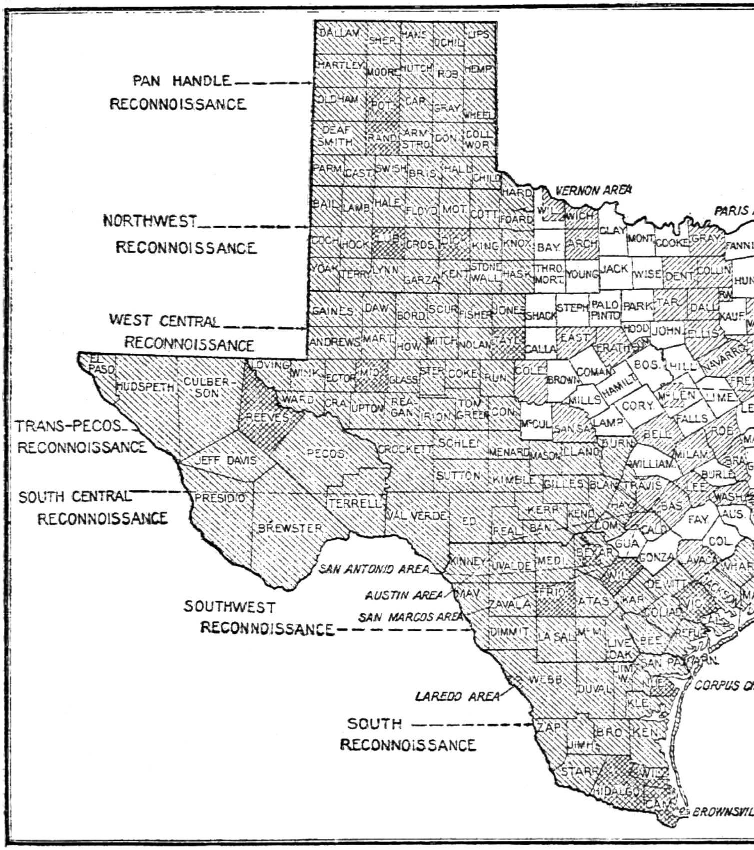
There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than 250 copies shall be for the use of each Senator from the State and not more than 1,000 copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in Texas, shown by shading. Detailed surveys shown by north
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SOIL MAP

COLLIN COUNTY
TEXAS

TEXAS AGRICULTURAL EXPERIMENT STATION
A. B. CONNER, DIRECTOR

LEGEND

- Bell clay (B)
- Houston clay (Hc)
- High-terrace phase (B)
- Shallow phase (W)
- Catalpa clay (Cy)
- Gray phase (W)
- Crockett very fine sandy loam (Cv)
- Lewisville clay (Lc)
- Houston black clay (Hb)
- Eroded phase (Lc)
- Shallow phase (Hb)
- Sumter clay (S)
- Colluvial phase (Hb)
- Trinity clay (T)
- Flat phase (Hb)
- Wilson clay loam (Wl)
- Chalk (*Houston material*) (Ch)
- Wilson clay (W)

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort.
Secondary roads and Trails
Railroads Steam and Electric
Bridges, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church Cemeteries
Mine or Quarry Mine dumps Made land
Bluff, Escarpment Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U. S. township and section lines

RELIEF
(Printed in brown or black)

Contours Depression contours
Prominent Hills Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

Streams
Lakes, Ponds Intermittent lakes
Intermittent streams
Springs, Canals and Ditches, Flumes
Swamp Salt marshes
Submerged marsh Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

William T. Carter, Acting Inspector, District 4.
Soils surveyed by M. W. Beck, in charge, and E. G. Fitzpatrick, U. S. Department of Agriculture, and L. G. Ragsdale, Texas Agricultural Experiment Station.

Scale 1 inch = 1 mile
1 ½ 0 1 2 3 4 Miles

Lith. A. Hoen & Co., Inc., Baltimore, Md.

Field Operations
Bureau of Chemistry and Soils
1930